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I, JULIE BILLINGSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2003901504 for a patent by ORICA EXPLOSIVES TECHNOLOGY PTY LTD as filed on 28 March 2003.

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J. Billingsley

JULIE BILLINGSLEY
TEAM LEADER EXAMINATION
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Regulation 3.2

Orica Explosives Technology Pty Ltd

AUSTRALIA

Patents Act 1990

PROVISIONAL SPECIFICATION

for the invention entitled:

"Transportation of Liquid Products"

The invention is described in the following statement:

TRANSPORTATION OF LIQUID PRODUCTS

The present invention relates to the transportation (delivery) of liquid products down conduits, such as pipes. The invention is particularly useful for the transportation of emulsion explosives to underground storage facilities, and the invention will be illustrated with reference to this specific application.

When a pipe is arranged vertically and filled with a liquid, gravity causes the liquid to exert a hydraulic pressure at the bottom of the pipe. This hydraulic pressure causes liquid to flow out of the bottom of the pipe. If the pipe is long, the hydraulic pressure can be high and this can lead to significant velocity and consequently turbulence in the liquid as it exits the pipe. This turbulence results in shearing of the liquid and this can be problematic if it alters the characteristics of the liquid. Heat can also be generated in the liquid.

One area where this problem is encountered is in underground mining where it is desired to transport an emulsion explosive from a surface to an underground storage facility. Any shearing of the emulsion explosive tends to cause a viscosity increase which makes subsequent use difficult. Conventional practice is to reduce the shearing effect by pumping the emulsion down relatively short pipes (such as less than 100m) so that the hydraulic pressure exerted by the liquid is relatively low. For greater depths an entirely different approach tends to be adopted where the emulsion is transported in individual batches using carrier vehicles. However, for relatively large depths this would require very long "tramming" distances because of the relatively gentle gradients over which such vehicles can operate. The transport process is also very time consuming as it involves repeat journeys of the carrier vehicle between a surface supply and the intended underground storage facility.

The present invention seeks to solve these problems by providing a method which enables liquid products to be delivered over relatively large distances (e.g. upto 600m) down a vertical conduit but which avoids any problems associated with shearing of the liquid product during transporation. The invention also seeks to provide a method which may be

operated in a continuous fashion and which avoids large "tramming" distances.

Accordingly, the present invention provides a method of transporting a liquid product down a vertical conduit having an inlet provided at the top of the conduit and an outlet provided at the bottom of the conduit, which method comprises feeding the liquid product into the inlet of the conduit and contacting the liquid product with means for dissipating potential energy released by the liquid product as it is transported down the conduit so that turbulence in the liquid product at the outlet of the conduit is reduced.

The crux of the present invention is the use of means for dissipating potential energy released by the liquid product as it is transported down the conduit. Without such means this potential energy is converted to kinetic energy which manifests itself as velocity, heat and turbulence as the product emerges from the outlet of the conduit. It will be appreciated that the means is essentially an energy dissipating device which prevents potential energy associated with the liquid product from being converted to kinetic energy within the liquid product. In the context of emulsion explosives it is also important that the means used does not cause heating of the liquid product. This could cause safety problems.

The means may be a pump the mechanism of which is actuated by movement of the liquid product through the pump and/or by contact of the liquid product with components of the pump. It will be appreciated that in this respect the moving liquid product does work on the pump rather than vice-versa. In this respect the pump functions as a turbine which is driven by movement of the liquid product through and/or in contact with it. The potential energy released by the liquid product may be converted to other forms of energy, such as electrical, mechanical and/or hydraulic energy by the "pump" and dissipated in this form. The effect is that liquid product emerging from the outlet of the conduit exhibits essentially non-turbulent flow thereby avoiding shearing.

The pump/turbine used is usually characterised by reference to a pressure rating and a suitable device may be selected with this in mind based on relevant factors such as the vertical distance over which the liquid product is to be transported. The pump/turbine may

be equipped with sensors to monitor its performance and operating characteristics (such as temperature and pressure). The pump/turbine is usually operated in order to achieve a target rate of flow at the outlet of the conduit.

The means will usually be provided at the bottom of the conduit close to the outlet thereof. Positioning the means here is most effective as opposed to another location between the inlet and outlet of the conduit. For conduits having a long length more than one means may be employed to manage the potential energy released. In this case, one means will still usually be provided adjacent the outlet of the conduit.

The present invention does not rely on a pump located at the top of the conduit to cause the liquid product to be transported down the conduit. In practice the hydraulic pressure exerted by a column of liquid product in the conduit is sufficient to cause the product to be forced from the outlet of the conduit. For continuous flow liquid product is supplied to the conduit inlet to maintain the column of liquid product therein.

The invention is useful for the transportation of any liquid product the characteristics of which are adversely affected (based on the intended use of the product) by shearing associated with turbulent flow of the liquid product. As noted the invention is particularly well suited to the transport of an emulsion explosive form a surface storage facility, such as a mobile vessel, to an underground storage facility. Emulsion explosives are well known in the art and usually comprise oil-in-water type emulsions in which the oil phase is a fuel and the aqueous phase a salt solution of oxidiser compounds. The emulsion explosive requires gassing (sensitisation) prior to use and this is usually done immediately before use. Thus, the emulsion is transported ungassed. The initial viscosity of the emulsion is usually from 25,000-40,000 cP at 25°C, e.g. around 30,000 cP at 25°C, and this viscosity is essentially unaffected after transportation in accordance with the present invention.

Some limited shearing of the liquid product can be tolerated during transportation in accordance with the invention provided that the viscosity increase does not make ultimate

use of the product untenable. For emulsion explosives an increase in viscosity of upto about 5,000 cP at 25°C may be tolerated in certain circumstances.

The conduit is invariably a pipe. The pipe is usually provided vertically in the strict sense, although the invention may be practised using pipes which are inclined to the vertical. When transporting an emulsion explosive the pipe is usually from 100-150 mm in diameter.

The invention may enable a liquid product to be transported over relatively large vertical distances without shearing of the liquid product at the outlet of the conduit. For instance, the invention may be used to transport an emulsion explosive through a pipe upto 600m in length. Usually, the length of the pipe exceeds 100m.

As noted, the invention is especially well-suited to the transportation of emulsion explosives and the following details illustrate how the invention may be used in this respect.

A pipe having a diameter from 100-150mm is provided between the surface and the inlet to an underground storage unit. The unit is typically provided at a depth of 100-600m. Emulsion is delivered from a surface supply vessel into the pipe via an inlet, thereby filling the pipe. A pump/turbine having a rating of 1,000 psi is provided at the bottom of the pipe in order to dissipate potential energy released as the emulsion flows down the pipe. The pump/turbine also controls the flow rate of the pipe outlet to between 300-500 kg/min. The emulsion has a viscosity of about 30,000 cP and 25°C. The emulsion emerging from an outlet provided at the bottom of the pipe feeds an underground storage facility where the emulsion is stored in ungassed form ready for use. When required, the emulsion may be transported to the blasting face for gassing and blasthole loading.

Dated this 28th day of March 2003
Orica Explosives Technology Pty Ltd
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Patent Attorneys for the Applicant(s)